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(12) (19) (CA) **Brevet-Patent**

(11) (21) (C) **2,139,925**
(86) 1993/07/10
(87) 1994/01/20
(45) 1998/12/22

(72) Merkenich, Karl, DE
(72) Maurer-Rothmann, Andrea, DE
(72) Scheurer, Günther, DE
(72) Walter, Edgar, DE
(72) Albertsen, Kristian, DK
(72) Wilmsen, Arnd, DK
(73) Danmark Protein A/S, DK

(51) Int.Cl.^{6} A23C 19/082, A23J 3/08
(30) 1992/07/11 (P 42 22 875.1) DE

(54) **UTILISATION D'UNE POUDRE DE PROTEINE DE LAIT STABILISEE POUR LA PRODUCTION DE PREPARATIONS DE FROMAGE FONDU ET DE FROMAGE ET METHODES DE FABRICATION DE CES PRODUITS**

(54) **USE OF STABILIZED MILK-PROTEIN POWDER IN THE PRODUCTION OF PROCESS CHEESE AND CHEESE PREPARATIONS, AND METHODS OF MANUFACTURING SUCH PRODUCTS**

(57) L'invention concerne l'utilisation, dans la production de préparations de fromage fondu et de fromage, d'une poudre sèche de protéines du lait stabilisées, ou de caséine, contenant entre 0,5 et 20 % de phosphate et/ou de citrate et dont la teneur en protéines est supérieure à 30 % par rapport au produit sec. L'invention concerne également des méthodes de fabrication de ces produits.

(57) The invention concerns the use, in the production of process cheese and cheese preparations, of stabilized milk protein, or casein, in the form of a dry powder containing 0.5 to 20% of phosphate and/or citrate and with a protein content of over 30% relative to the dry product. The invention also concerns methods of manufacturing such process cheese and cheese preparations.

ABSTRACT OF THE DISCLOSURE

The invention concerns the use, in the production of process cheese and cheese preparations, of stabilized milk protein, or casein, in the form of a dry powder containing 0.5 to 20% of phosphate and/or citrate and with a protein content of over 30% relative to the dry product. The invention also concerns methods of manufacturing such process cheese and cheese preparations.

The present invention concerns the use of stabilised protein powders for the production of processed cheese and cheese preparations, as well as processes for their production.

Processed cheese preparations were already produced for the first time in the year 1911 and later, with changing composition of the starting materials, continuously improved in flavour, in appearance and in the texture. Depending upon the composition, there can thereby be obtained spreadable or cuttable products. Starting material is a cuttable cheese, such as Gouda, Emmentaler etc., which is comminuted and mixed and melted at temperatures of about 80 to 95°C together with fat, especially butter, and processing salts, as well as possibly some water, whereafter the mass is shaped, cooled and packed. As processing salts, there are used trisodium citrate or sodium phosphate or their mixtures, mostly in the form of commercially available hydrates. Furthermore, processed cheese frequently also contain binding agents or thickeners, for example starch, guar flour, pectin, carboxymethylcellulose, agar agar, alginates or similar products. Instead of the expensive hard cheeses, there can also be used, to a small extent, cheese substitute materials, such as

casein, whey powder, curds, yoghurt, milk protein, and, to a certain extent, also vegetable proteins, especially soya protein. In this connection, the use of natural milk proteins, such as they occur in whey powder and casein, would be especially interesting.

However, it is known that these may be added to the processed cheese only in small amounts - whey powder up to about 2%, casein up to about 10%, rennet casein up to 20% - of the processed cheese mass since, in the case of larger amounts, these proteins crystallise out from the processed cheese mass and thus impart a "sandy consistency" to the processed cheese or become visible as strippling or even impart a bitter teste to the whole mass. (Die Schmelzkäseherstellung, Johaleitfaden, Benckiser Knapsack, 1989, pages 93-96).

Therefore, the task exists so to change whey proteins or casein, respectively, that they can be added to a processed cheese preparation in amounts of 10 to 20% without precipitating out or changing the taste of the product.

Surprisingly, this task is solved by the features set out in the main claims and promoted by the features set out in the subsidiary claims.

According to DE-AS 25 22 508, a suspension of casein which contains not more than 270 g casein/l is first ripened with citric acid or phosphoric acid at pH values of "not under 4.6" and subsequently, by addition of alkali, the pH value is again lowered to

6.8 to 7.5, respectively. The so-obtained products can be concentrated or dried by some process and thereby give a caseinate which can be directly dissolved in water, whereby a true solution or a colloidal solution of a gel is obtained. The usability of such products in cheese preparations, in which it is a question of the emulsifiability of the proteins, is not described.

In EP 0 076 685 is described a process for the production of whey proteins which display an improved gel formation, whereby the pH value of the whey protein solution is first to be increased to 8.5 - 11.5 in order to increase the "sulphhydryl group count", whereafter to the solution are first added comparatively weak acids, such as citric acid, phosphoric acid or polyphosphoric acid, and subsequently a strong acid, such as hydrochloric acid or sulphuric acid, in order to adjust the pH of the solution to 6 to 8. Due to the depolymerisation of the sulphhydryl groups in alkaline solution, the water solubility is, on the one hand, improved and, due to recombination of sulphhydryl bridges, on the other hand, the gel formation is brought about. A use of such products as additives in processed cheese is not to be deduced from this document.

From Journal of Food Science, 1984, No. 1, pages 32, 33 and 39 is known again to dissolve whey powder (WPC - whey protein concentrates) in water for the

further working up in that one adds a sodium orthophosphate in an amount of 0.1 – 0.25% referred to the protein powder and tempers the solution to 75 - 85°C before a heat sterilisation is carried out. For the redissolving, it is possible but less favourable to add the phosphate already in the case of the production of the whey powder. Surprisingly, however, such products are very well suited for the production of processed cheese, whereas the subsequent addition of phosphates to once dried WPC prove to be useless.

The proteins used according to the invention can be added to a processed cheese preparation in amounts of up to 20%, whereby, in wide limits, whey protein can replace the casein previously added in amounts of about 5 to 10% for the achievement of the necessary hardness of the cheese preparations. The native whey protein powder stabilised with phosphates or citrates can dissolve surprisingly easily in the cheese mass and do not tend to crystallisation so that the produced processed cheese display neither a sandy texture nor external stipples even after comparatively long storage.

It is assumed that this stabilisation is to be attributed to the fact that phosphate or citrate molecules become incorporated under the conditions according to the invention into the tertiary structure of the proteins so that this is stabilised in the subsequent drying. It is thereby decisive that the proteins must obviously be treated in solution with

these compounds since once precipitated out and dried proteins cannot be converted or only after a very long period of time, by resuspending in water and treatment with phosphates or citrates, into the corresponding structure conducive for a mixing with the processed cheese. A mixing of whey protein in unstabilised form with addition of sodium phosphates or citrates even in the substantially higher concentrations in which they are used as processing salts (1.5 to 3%) leads - as said above - also no longer to a subsequent stabilisation so that such products, according to the prior art, should also only be added in small amount.

For the production of the stabilised whey powder, one preferably starts from the whey obtained in large amounts in the production of curds and cheese which is concentrated by ultrafiltration or other known processes and, at the same time, is freed from a part of lactose and salts contained. An average whey thereby contains about 0.9% protein, 0.1% fat, 4.5% lactose and 0.7 g inorganic salts. Such a whey is concentrated, for example, to 30% dry weight, whereby the concentrate contains, for example, 16% protein (56% in the dry weight), 1.6% fat (5.6% in the dry weight), 9.5% lactose (33% in the dry weight) and 1.4% inorganic salts (5% in the dry weight). To this concentrate are added 0.2 to 5% of a processing salt of the group ortho-, di-, pyro- and polyphosphate (together designated as phosphate) and citrate, whereby the sodium salts are preferred

but potassium or ammonium salts also come into question. The addition should amount to about 0.5 to 20% of the protein concentration, whereby, having regard to the stabilisation, the concentration of 1 to 5% gives the optimum values. Amounts above 20% are uneconomic since normally the processing salt concentration necessary for the production of the processed cheese is therewith also exceeded. A concentration of below 0.2% of the solution or below 0.5% of the protein concentration used does not bring about a sufficient stabilisation so that these products do not differ from known whey protein powders. The addition of the stabilisers preferably takes place as a 1 to 10% solution in water and it is, however, also possible to add higher concentrations, for example 10 to 50%, as slurry in order thereby not to dilute the protein solution unnecessarily. An addition as dry powder is admittedly possible but, because of poor miscibility, not preferred.

The addition of the processing salts as stabilising agent takes place in a pH range between 2.8 and 8.0, preferably in the pH range of about 7.0 to 4.0, in which the protein solutions in question are stable. In order to accelerate the equilibrium adjustment between phosphate and protein, it has proved to be advantageous to warm the solutions, whereby temperatures of 35 to 150°C, preferably 50 to 90°C, are used and, depending upon the temperature, reaction times of 2 sec. to about 10 min. are necessary. In the case of

temperatures above the boiling point, one must naturally work with a corresponding overpressure. The warming can take place by means of appropriate heat exchangers, such as plate heat exchangers, tube heaters, chafing heaters or by direct or indirect heating with steam.

The drying of the protein solution according to the invention to the stable end product takes place in the usual way with spray driers, spray towers, fluidised bed driers but also with roller driers and other known apparatus. The moisture content of the end product should lie below 7%, preferably 2 - 5%.

By means of the joint spraying of the whey with processing salts, especially phosphates, it is possible decisively to improve the functional properties of these proteins. These functionally changed proteins can be used in processed cheese, processed cheese preparations, fresh cheese and fresh cheese preparations of processed cheese, imitation cheese, reconstitutions, pizza toppings, bread spreads, cheese dips and cheese sauces, whereby amounts of 5 to 10% whey protein (WPC) do not change consistency, appearance and taste of the finished product. In the case of smaller amounts of the proteins according to the invention or in the case of a smaller processing salt content thereof, to the cheese mixture must naturally also be added the necessary additional amounts of processing salt in the usual way. The other components of these

processed cheese compositions according to the invention correspond to that which is analogously known for such productions.

The following flow scheme, whereby differing concentration and product composition were used for whey proteins, gives the carrying out of the process according to the invention.

dry weight (5)	protein in dry weight (%)	product name
15 - 50	33 ± 3	WPC-30
15 - 50	55 ± 3	WPC-50
15 - 50	65 ± 3	WPC-60
15 - 50	77 ± 3	WPC-70
15 - 50	84 ± 2	WPC-76
10 - 40	91 ± 2	WPC-83
10 - 40	96 - 2	WPC-88

1. All WPC types (whey protein concentrate) can be produced not only with sweet but also with acidic whey.

In the case of use of these whey types, one obtains a WPC between pH 2.8 and 8.0.

2. Added amount of the phosphates or citrates or mixtures of phosphates and citrates: 0.5 to 20%, preferably 1.0 to 5%, calculated on the dry weight of the whey protein concentrate solution; addition as 1 to 10% solution or 10 to 50% slurry.

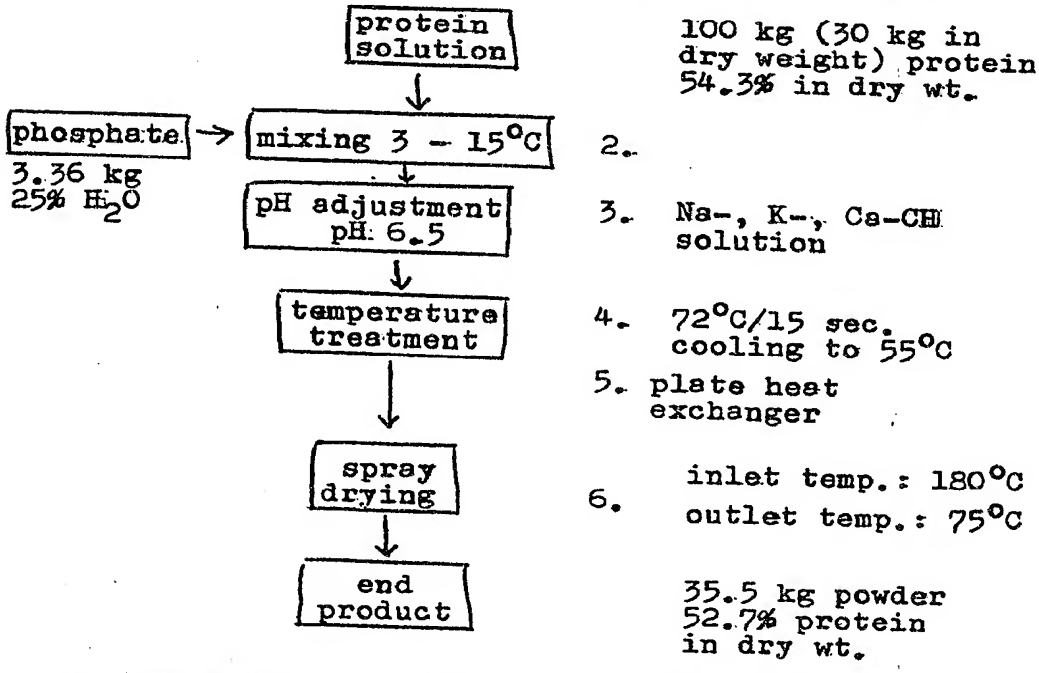
3. pH range for the pH adjustment 2.8 to 8.0.

4. Temperature treatment in a T-range between 35 to 150°C, period of time: 1 sec to 10 min.

5. Heat transmission: plate heat exchanger, tube heater, chafe heater, direct or indirect UHT process.

6. Spray drying: spray tower; nozzle or rotation spraying; e.g. niro atomiser, swirl fluidised, roller drying, belt dried; e.g. filter mat type.

Description of the production process



For the use of the products according to the invention for the production of processed cheese preparations, some examples are enclosed which explain the invention but are not to limit. As one can see from the examples, a stabilisation of the whey proteins brings about a substantial improvement

of the appearance and of the consistency of the cheese obtained. Protein proportion in the whey proteins of below 30% in the dry substance or an insufficient phosphate stabilisation (native proteins) proves to be not usable.

Example 1

Spreadable processed cheese preparation
(49% dry wt. - 61% fat in dry wt.)
addition 5% whey protein (96% protein) in end product

Basic recipe

750.0 g Cheddar (50% fat in dry wt.)
750.0 g Gouda (50% fat in dry wt.)
521.7 g butter (84%)
75.0 g whey protein 96% in dry substance
47.3 g JOHA S 9
815.2 g water inc. condensate

Heating of the additives within 9 min to 90 to 92°C, direct steam introduction; stirring speed 120 r.p.m.
Variants (for 5% WP 96%) of the above-mentioned basic recipe:

a. native whey protein with a protein content of 80%
sensory assessment:
appearance outer: sticks to the foil
inner: coarse
consistency : too solid, atypical
taste : not marked

b. native whey protein, protein content 60%

sensory asessment:

appearance outer: sticks to the foil

inner: coarse

consistency : too solid, atypical

taste : not marked

c. native whey protein, protein content 35%

sensory assessment:

appearance outer: sticks to the foil

inner: coarse

consistency : too solid, atypical

taste : not marked

d. whey protein modified with JOHA SDS 2, protein content 80%

sensory assessment:

appearance outer: sticks slightly to the foil

inner: in order

consistency : creamy

taste : typical

e. whey protein modified with JOHA S 9, protein content 80%

sensory assessment:

appearance outer: sticks slightly to the foil

inner: in order

consistency : creamy

taste : typical

f. whey protein modified with JOHA SDS 2, protein content 60%

sensory assessment:

appearance outer: sticks slightly to the foil

inner: in order

consistency : creamy

taste : typical

g. whey protein modified with JOHA S 9, protein content 60%

sensory assessment:

appearance outer: sticks slightly to the foil

inner: in order

consistency : creamy

taste : typical

h. whey protein modified with JOHA SDS 2, protein content 30%

sensory assessment:

appearance outer: sticks to the foil

inner: slightly coarse

consistency : atypical, coarse

taste : not marked

i. whey protein modified with JPHA S 9, protein content 30%

sensory assessment:

appearance outer: sticks to the foil

inner: slightly coarse

consistency : atypical, coarse

taste : not relevant

The 60% and 80% whey proteins modified with JOHA SDS 2 and with JOHA S 9 show in the end product a loose, shiny and creamy consistency. However, modified proteins from 30% protein are also still usable.

The non-modified whey proteins, as well as modified whey proteins with protein contents below 30% do not show the desired results. The consistency of these processed cheeses is too solid, coarse, the surface is dull, one sees stipples.

For the modification of the whey proteins with phosphates, with JOHA SDS 2 was chosen a phosphate combination with highest possible orthophosphate part, with JOHA S 9 was used a phosphate mixture with highest possible polyphosphate part.

Example 2

Production of block processed cheese (54% dry wt. - 48% in the dry wt.)

Replacement of rennet casein by modified whey protein basic recipe (comparison):	(invention)
1000.0 g Chester (50% FiD)	
250.0 g. Gouda (50% FiD)	ditto
250.0 g Viereck hard cheese (45% FiD)	
80.0 g butter (94%)	
15.0 g JOHA PZ 7	
6.0 g JOHA T	
80.0 g rennet casein	80.0 g whey protein (protein content about 73%)(phosphate content 3%)

Melting period 10 min., 120 r.p.m., melt temperature 70 to 75°C; 350.0 g water, inc. condensate (addition 200 g)(FiD = fat in dry weight)

Assessment of the remeltability:

	invention with WP	comparison rennet casein
a. rubbability	slightly sticky	in order
grillability		
after 5 days:	good	nil
after 20 days:	good	slight
toastability		
after 5 days:	in order	in order
after 20 days:	toast value 4	toast value 6
fat loss		
after 5 days:	excellent	no
after 20 days:	little	scarcely
threadiness		
after 5 days:	no	no
after 20 days:	slight	slight

Production of modified whey proteins

1. Modificiation with JOHA SDS, JOHA S 9

Protein contents 30 to 80%

Analysis:

		WP 80%	A 1	A 2
total P_2O_5 (%)	:	0.96	2.29	2.47
P-chrom.	:	mono	mono, start	mono, start
protein (%)	:	75.61	76.94	77.64
ash (%)	:	2.34	4.33	4.58
pH (10%)	:	--	6.4	6.5
solubility	:	96%	--	98%

A 1 and A 2 = modified whey proteins

WP 80 = non-modified whey protein concentrate

Addition of a 25 to 30% slurry, referred to the retentate 1% JOHA S 9 or 1% JOHA SDS 2, respectively. (JOHA is a Registered Trade Mark of the Applicant).

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. The use of whey protein for the production of processed cheese, in which stabilised whey protein powders which are obtained by mixing protein-enriched whey concentrate with 0.5 - 20% of phosphate and/or citrate, based on the amount of protein, heating the mixture to a temperature of 35° - 150°C and subsequently drying it, whereby the amount of protein is greater than 30% of the dry substance of the whey powder, the whey protein powder being added to the cheese mass in an amount of up to 20 wt.%.

2. Use of a whey protein powder according to claim 1, wherein it contains 1% to 5% of phosphate or citrate.

3. Use of a whey protein powder according to claim 1 or 2, wherein it has an amount of protein of 50% to 96%.

4. Use of a whey protein powder according to claim 1, 2 or 3, wherein it contains 0% - 60% lactose and 0% to 10% of inorganic and organic salts from the whey.

5. Use of a whey protein powder according to any one of claims 1 to 4, in which the powder still contains 2 to 7% of water.

6. Use of a whey protein powder according to any one of claims 1 to 5, in which sweet or acidic whey is adjusted with partial removal of water, lactose and dissolved salts by ultrafiltration to a protein content of 3% to 30% in the solution, and a protein content in the dry mass of 30% to 96%, before the phosphate or citrate is added thereto.

7. Use of whey protein powder according to any one of claims 1 to 6, in which the mixture is heated to a temperature in the range of 50° to 90°C.

8. Use of whey protein powder according to any one of claims 1 to 7, in which the whey protein powder is added to the cheese mass in an amount of 5 to 10 wt.%.

9. A process for the production of processed cheese with use of whey protein powder as defined in any one of claims 1 to 8, characterised by mixing cheese, fat, processing salts, water and other usual components with up to 20 wt.% of the whey protein powder, melting the mixture, forming the melt mass, and cooling it.

10. A process for the production of processed cheese according to claim 9, in which the components are mixed with 10 to 20 wt.% of the whey protein powder.